Pushing the Boundaries of Low-Level GC-MS Semivolatiles Analysis

By Jessi Collier, Erica Pack, Ramkumar Dhandapani, and Colton Myers

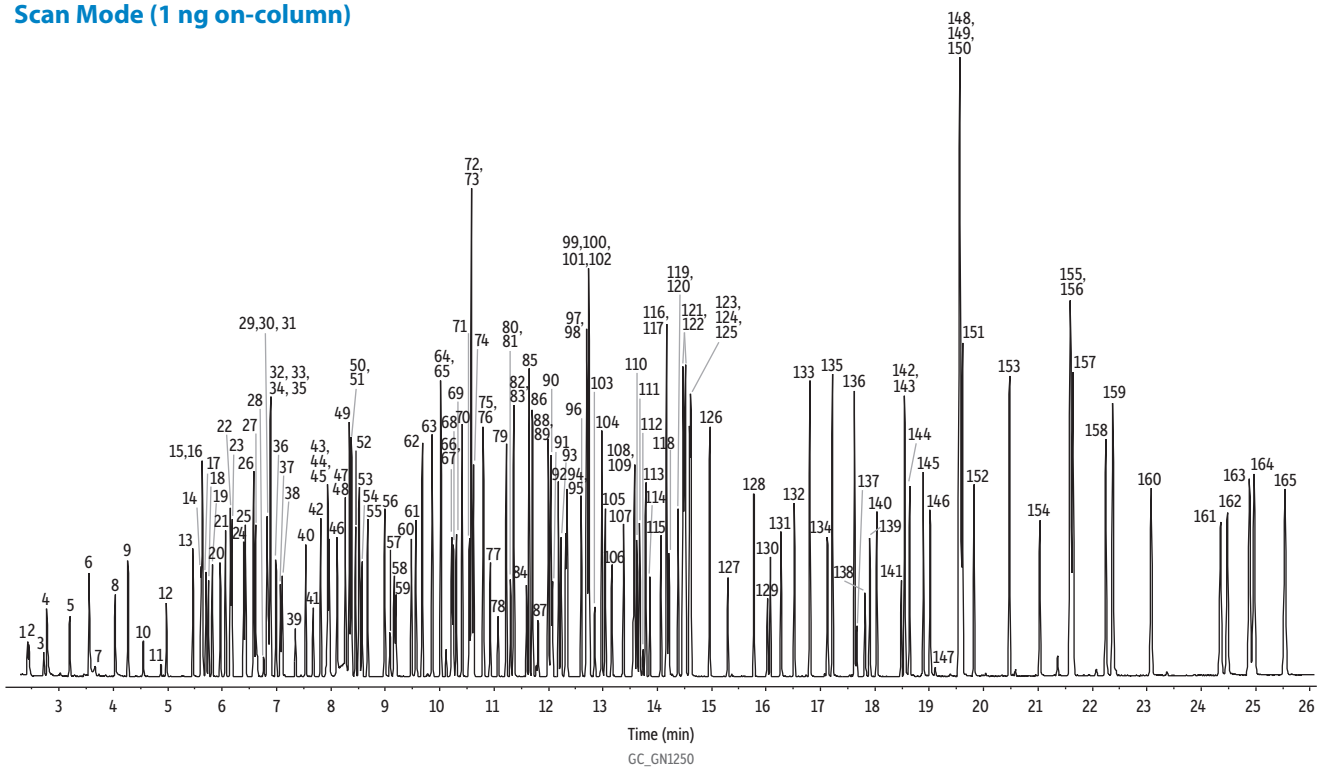
- Leverage next-generation TriMax column deactivation to lower detection limits and still meet data quality requirements.
- Exceptionally inert sample flow path ensures sharp, symmetrical peaks for a wide range of challenging semivolatiles.
- Established GC-MS conditions for both a robust scan method and a sensitive SIM method.

Environmental laboratories analyzing semivolatiles are under continual pressure to achieve lower detection limits due to customer demands or the need to reduce solvent use for either regulatory reasons or to reduce costs and improve profitability. MS-based methods, such as EPA Method 8270, are a common approach for analysis, and offer scientists the flexibility of choosing instrumentation to achieve the lowest possible limits of detection via MS. Some labs may opt for sensitive instrumentation, such as GC-MS/MS, or use GC-MS with selected ion monitoring (SIM), while others may opt for more traditional scan methods. SIM and scan methods can typically be performed on the same instrument, where scan methods are simple and versatile, collecting signals for a range of compound masses, while SIM allows for greater sensitivity for specific ions in specific retention time windows. SIM methods are typically more complicated to set up and maintain, but as labs explore strategies to lower detection limits, GC-MS in SIM mode may be considered as an alternative to GC-MS/MS without labs having to budget for a new instrument.

In this study, we established conditions for GC-MS semivolatiles analysis under both scan and SIM modes to provide labs with both a simple, robust scan workflow as well as a highly sensitive SIM alternative to GC-MS/MS (Figure 1). An RMX-5Sil MS column was selected for both methods because it provides standard 5sil selectivity with a next-generation TriMax deactivation that has been proven to provide an exceptionally inert sample flow path [1,2]. As shown in Figure 1, peak asymmetry consistently met quality objectives (≤2) for key analytes (benzidine, pentachlorophenol, and 2,4-dinitrophenol). In addition, resolution criteria (>50%) were easily met for challenging PAHs with the valley between benzo[b]fluoranthene and benzo[k]fluoranthene >94%, and the valley between indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene >95%. Using an RMX-5Sil MS column under the conditions shown here, excellent results were obtained for a wide range of semivolatiles at very low levels (1 ng on-column in scan mode and 200 pg on-column in SIM mode), allowing labs to work confidently at the lower end of MS detection limits.

Figure 1: RMX-5Sil MS columns provide outstanding chromatographic results for 165 semivolatiles analyzed at low levels by GC-MS.

Scan Mode (1 ng on-column)



Column	RMX-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 17323)
Standard/Sample	
	Methapyrilene (cat.# 32460)
	Appendix IX mix #1, revised (cat.# 32459)
	SVOC additions (cat.# 31909)
	Benzoic acid (cat.# 31879)
	8270 MegaMix (cat.# 31850)
	Appendix IX mix #2 (cat.# 31806)
	Acid surrogate mix (4/89 SOW) (cat.# 31025)
	Base neutral surrogate mix (4/89 SOW) (cat.# 31024)
	Revised SV internal standard mix (cat.# 31886)
Diluent:	Methylene chloride
Conc.:	1 µg/mL
Injection	
Inj. Vol.:	1 µL split (split ratio 10:1)
Liner:	Topaz 4.0 mm ID single taper liner w/wool (cat.# 23303)
Inj. Temp.:	250 °C
Split Vent Flow Rate:	12 mL/min
Oven	
Oven Temp.:	40 °C (hold 1 min) to 280 °C at 12.4 °C/min to 330 °C at 3.3 °C/min (hold 3.65 min)
Carrier Gas	He, constant flow
Flow Rate:	1.2 mL/min
Linear Velocity:	39.7 cm/sec
Detector	MS
Mode:	Scan
Scan Program:	

Group	Start Time (min)	Scan Range (amu)	Scan Rate (scans/sec)
1	2	35-550	5

Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Source Temp.:	330 °C
Quad Temp.:	180 °C
Solvent Delay Time:	2 min
Tune Type:	PFTBA
Ionization Mode:	EI
Instrument	Agilent 7890B GC & 5977B MSD
Notes	To simplify ordering, the SVOC MegaMix 150 kit (cat.# 31907) contains one ampul each of the following standards that were used in this experiment.

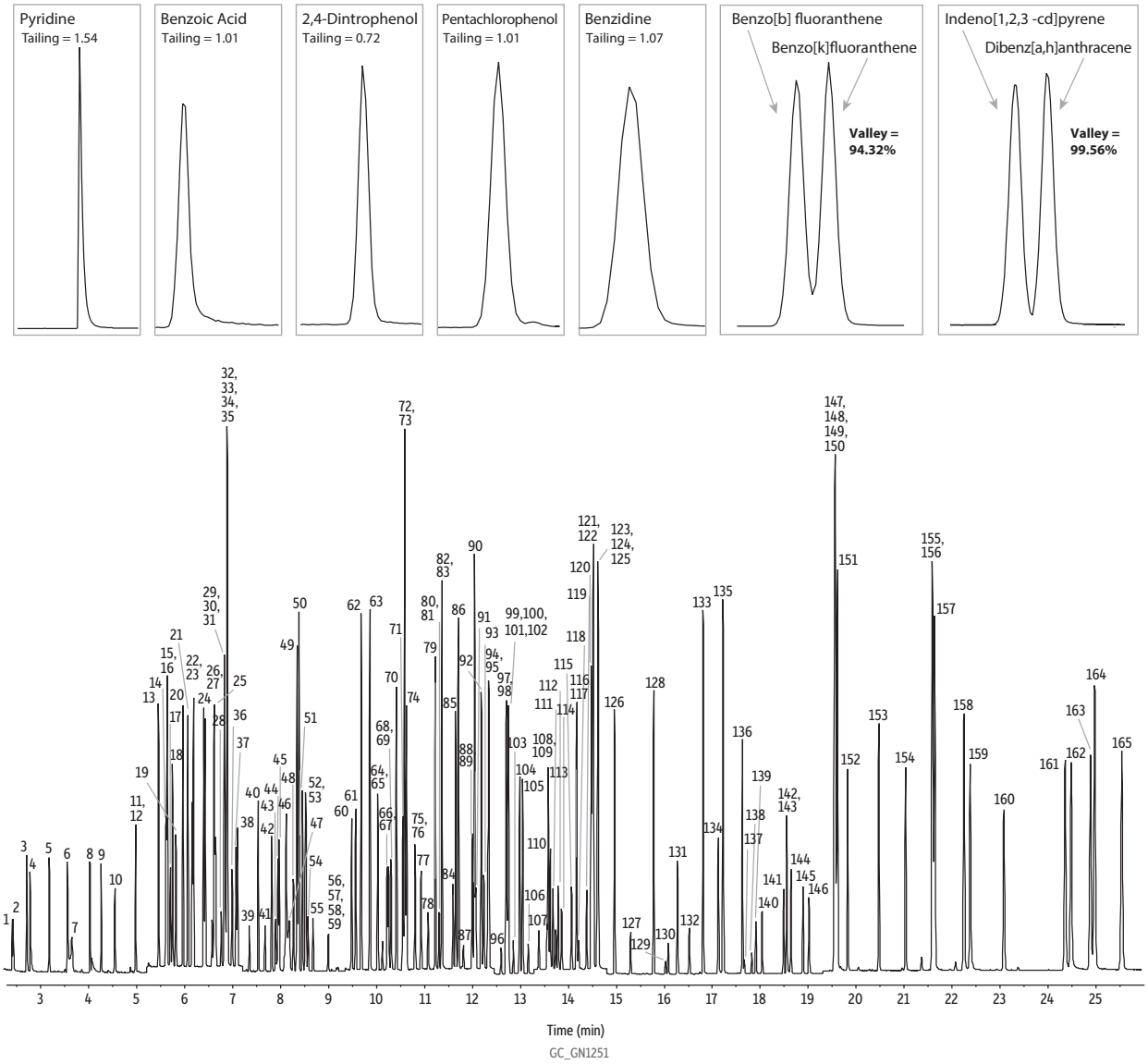
- 8270 MegaMix (cat.# 31850)
- SVOC Additions standard (cat.# 31909)
- Appendix IX mix #1, revised (cat.# 32459)
- Methapyrilene (cat.# 32460)
- Appendix IX mix #2 (cat.# 31806)
- Benzoic acid (cat.# 31879)

Figure 1: RMX-5Sil MS columns provide outstanding chromatographic results for 165 semivolatiles analyzed at low levels by GC-MS. (cont.)

	Peaks	t_R (min)	Conc. (µg/mL)
1.	1,4-Dioxane-d8	2.400	1
2.	1,4-Dioxane	2.428	1
3.	N-Nitrosodimethylamine	2.702	1
4.	Pyridine	2.774	1
5.	Ethyl methacrylate	3.175	1
6.	2-Picoline	3.554	1
7.	N-Nitrosomethylethylamine	3.648	1
8.	Methyl methanesulfonate	4.021	1
9.	2-Fluorophenol	4.258	1
10.	Acrylamide	4.543	1
11.	N-Nitrosodiethylamine	4.875	1
12.	Ethyl methanesulfonate	4.977	1
13.	Benzaldehyde	5.454	1
14.	Phenol-d6	5.612	1
15.	Phenol	5.629	1
16.	Aniline	5.638	1
17.	Pentachloroethane	5.705	1
18.	Bis(2-chloroethyl)ether	5.743	1
19.	2-Chlorophenol	5.814	1
20.	n-Decane (C10)	5.962	1
21.	1,3-Dichlorobenzene	6.066	1
22.	1,4-Dichlorobenzene-d4	6.153	1
23.	1,4-Dichlorobenzene	6.180	1
24.	Benzyl alcohol	6.393	1
25.	1,2-Dichlorobenzene	6.426	1
26.	2-Methylphenol (o-cresol)	6.612	1
27.	2,2'-Oxybis(1-chloropropane)	6.634	1
28.	N-Nitrosopyrrolidine	6.765	1
29.	Acetophenone	6.825	1
30.	N-Nitrosomorpholine	6.836	1
31.	N-Nitroso-di-n-propylamine	6.847	1
32.	3-Methylphenol (m-cresol)	6.885	1
33.	4-Methylphenol (p-cresol)	6.885	1
34.	Indene	6.885	1
35.	o-Toluidine	6.890	1
36.	Hexachloroethane	6.989	1
37.	Nitrobenzene-d5	7.067	1
38.	Nitrobenzene	7.101	1
39.	N-Nitrosopiperidine	7.347	1
40.	Isophorone	7.536	1
41.	2-Nitrophenol	7.673	1
42.	2,4-Dimethylphenol	7.816	1
43.	Benzoic acid	7.943	1
44.	O,O,O-Triethyl phosphorothioate	7.943	1
45.	Bis(2-chloroethoxy)methane	7.970	1
46.	2,4-Dichlorophenol	8.113	1
47.	α,α-Dimethylphenethylamine (phentermine)	8.268	1
48.	1,2,4-Trichlorobenzene	8.268	1
49.	Naphthalene-d8	8.342	1
50.	Naphthalene	8.376	1
51.	α-Terpineol	8.451	1
52.	4-Chloroaniline	8.519	1
53.	2,6-Dichlorophenol	8.519	1
54.	Hexachloropropene	8.571	1
55.	Hexachlorobutadiene	8.674	1
56.	Quinoline	8.988	1
57.	ε-Caprolactam	9.085	1
58.	1,4-Phenylenediamine	9.160	1
59.	N-Nitrosodibutylamine	9.195	1
60.	4-Chloro-3-methylphenol	9.480	1
61.	Isosafrole isomer 2	9.560	1
62.	2-Methylnaphthalene	9.680	1
63.	1-Methylnaphthalene	9.857	1
64.	1,2,4,5-Tetrachlorobenzene	10.023	1
65.	Hexachlorocyclopentadiene	10.023	1
66.	2,3-Dichloroaniline	10.217	1
67.	Isosafrole isomer 1	10.217	1
68.	2,4,6-Trichlorophenol	10.248	1
69.	2,4,5-Trichlorophenol	10.303	1
70.	2-Fluorobiphenyl	10.412	1
71.	Safrole	10.547	1
72.	Biphenyl	10.585	1
73.	2-Chloronaphthalene	10.585	1
74.	1-Chloronaphthalene	10.623	1
75.	2-Nitroaniline	10.801	1
76.	Diphenyl ether	10.801	1
77.	1,4-Naphthoquinone	10.926	1
78.	1,4-Dinitrobenzene	11.075	1
79.	Dimethylphthalate	11.224	1
80.	1,3-Dinitrobenzene	11.304	1
81.	2,6-Dinitrotoluene	11.304	1
82.	1,2-Dinitrobenzene	11.361	1
83.	Acenaphthylene	11.361	1
84.	3-Nitroaniline	11.595	1
85.	Acenaphthene-d10	11.647	1
86.	Acenaphthene	11.704	1
87.	2,4-Dinitrophenol	11.809	1
88.	4-Nitrophenol	11.996	1
89.	Pentachlorobenzene	11.996	1
90.	Dibenzofuran	12.040	1
91.	2,4-Dinitrotoluene	12.070	1
92.	1-Naphthylamine (1-aminonaphthalene)	12.184	1
93.	2,3,5,6-Tetrachlorophenol	12.236	1
94.	2,3,4,6-Tetrachlorophenol	12.319	1
95.	2-Naphthylamine (2-aminonaphthalene)	12.341	1
96.	Diethylphthalate	12.602	1
97.	n-Hexadecane (C16)	12.699	1
98.	Fluorene	12.699	1
99.	Zalophus (thionazine)	12.745	1
100.	4-Chlorophenyl phenyl ether	12.745	1
101.	4-Nitroaniline	12.745	1
102.	5-Nitro-o-toluidine	12.745	1
103.	4,6-Dinitro-2-methylphenol (Dinitro-o-cresol)	12.853	1
104.	Diphenylamine†	12.979	1
105.	Azobenzene*	13.042	1
106.	2,4,6-Tribromophenol	13.162	1
107.	Sulfotepp	13.379	1
108.	1,3,5-Trinitrobenzene	13.579	1
109.	Phorate	13.579	1
110.	Phenacetin	13.625	1
111.	4-Bromophenyl phenyl ether	13.677	1
112.	Diallate	13.734	1
113.	Hexachlorobenzene	13.785	1
114.	Dimethoate	13.865	1
115.	Atrazine	14.071	1
116.	4-Aminobiphenyl	14.168	1
117.	Pentachlorophenol	14.170	1
118.	Pentachloronitrobenzene (Quintozene)	14.214	1
119.	Propyzamide	14.380	1
120.	Phenanthrene-d10	14.477	1
121.	n-Octadecane (C18)	14.517	1
122.	Phenanthrene	14.517	1
123.	Dinoseb	14.599	1
124.	Disulfoton	14.599	1
125.	Anthracene	14.614	1
126.	Carbazole	14.963	1
127.	Methyl parathion	15.295	1
128.	Di-n-butyl phthalate	15.775	1
129.	4-Nitroquinoline-N-oxide	16.027	1
130.	Parathion (ethyl parathion)	16.078	1
131.	Methapyrilene hydrochloride	16.273	1
132.	Isodrin	16.518	1
133.	Fluoranthene	16.804	1
134.	Benzidine	17.127	1
135.	Pyrene	17.222	1
136.	p-Terphenyl-d14	17.622	1
137.	Aramite isomer 2	17.668	1
138.	Aramite isomer 1	17.822	1
139.	p-Dimethylaminoazobenzene	17.908	1
140.	Chlorobenzilate	18.034	1
141.	Famphur	18.485	1
142.	3,3'-Dimethylbenzidine (o-tolidine)	18.548	1
143.	Kepone	18.548	1
144.	Benzyl butyl phthalate	18.640	1
145.	Bis(2-ethylhexyl)adipate	18.891	1
146.	2-Acetylaminofluorene	19.017	1
147.	4,4'-Methylene-bis(2-chloroaniline)	19.108	1
148.	3,3'-Dichlorobenzidine	19.560	1
149.	Benz[a]anthracene	19.560	1
150.	Chrysene-d12	19.560	1
151.	Chrysene	19.612	1
152.	Bis(2-ethylhexyl)phthalate	19.823	1
153.	6-Methylchrysene	20.475	1
154.	Di-n-octyl phthalate	21.030	1
155.	Benzo[b]fluoranthene	21.590	1
156.	7,12-Dimethylbenz[a]anthracene	21.590	1
157.	Benzo[k]fluoranthene	21.641	1
158.	Benzo[a]pyrene	22.248	1
159.	Perylene-d12	22.379	1
160.	3-Methylcholanthrene	23.082	1
161.	Dibenz(a,h)acridine	24.357	1
162.	Dibenz[a,j]acridine	24.483	1
163.	Indeno[1,2,3-cd]pyrene	24.883	1
164.	Dibenz[a,h]anthracene	24.969	1
165.	Benzo[g,h,i]perylene	25.541	1

Figure 1: RMX-5Sil MS columns provide outstanding chromatographic results for 165 semivolatiles analyzed at low levels by GC-MS. (cont.)

SIM Mode (200 pg on-column)



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	Acid surrogate mix (4/89 SOW) (cat.# 31025)
	Base neutral surrogate mix (4/89 SOW) (cat.# 31024)
	Revised SV internal standard mix (cat.# 31886)
Diluent:	Methylene chloride
Conc.:	200 ng/mL
Injection	
Inj. Vol.:	1 µL split (split ratio 10:1)
Liner:	Topaz 4.0 mm ID single taper liner w/wool (cat.# 23303)
Inj. Temp.:	250 °C
Split Vent Flow Rate:	12 mL/min
Oven	
Oven Temp.:	40 °C (hold 1 min) to 280 °C at 12.4 °C/min to 330 °C at 3.3 °C/min (hold 3.65 min)
Carrier Gas	He, constant flow
Flow Rate:	1.2 mL/min
Linear Velocity:	39.7 cm/sec
Detector	MS
Mode:	SIM

SIM Program:

Group	Start Time (min)	Ion(s) (m/z)	Dwell (ms)
1	2	see peak list	300
2	5.2	see peak list	286
3	7.2	see peak list	289
4	9.35	see peak list	285
5	10.7	see peak list	273
6	12.45	see peak list	290
7	13.29	see peak list	280
8	14.8	see peak list	300
9	17.4	see peak list	297
10	19.3	see peak list	285

Transfer Line Temp.:	280 °C
Analyzer Type:	Quadrupole
Source Temp.:	330 °C
Quad Temp.:	180 °C
Solvent Delay Time:	2 min
Tune Type:	PFTBA
Ionization Mode:	EI
Instrument	Agilent 7890B GC & 5977B MSD
Notes	To simplify ordering, the SVOC MegaMix 150 kit (cat.# 31907) contains one ampul each of the following standards that were used in this experiment.

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- Appendix IX mix #2 (cat.# 31806)
- Benzoic acid (cat.# 31879)

Figure 1: RMX-5Sil MS columns provide outstanding chromatographic results for 165 semivolatiles analyzed at low levels by GC-MS. (cont.)

	Peaks	t_R (min)	Conc. (ng/mL)	SIM Ion	Dwell Time (ms)	Ion Group
1.	1,4-Dioxane-d8	2.401	200	96	25	1
2.	1,4-Dioxane	2.427	200	88	25	1
3.	N-Nitrosodimethylamine	2.702	200	74	25	1
4.	Pyridine	2.774	200	79	25	1
5.	Ethyl methacrylate	3.175	200	69	25	1
6.	2-Picoline	3.554	200	93	25	1
7.	N-Nitrosomethylethylamine	3.648	200	42	25	1
8.	Methyl methanesulfonate	4.021	200	80	25	1
9.	2-Fluorophenol	4.258	200	112	25	1
10.	Acrylamide	4.543	200	71	25	1
11.	N-Nitrosodiethylamine	4.977	200	102	25	1
12.	Ethyl methanesulfonate	4.977	200	109	25	1
13.	Benzaldehyde	5.454	200	77	11	2
14.	Phenol-d6	5.612	200	99	11	2
15.	Phenol	5.633	200	94	11	2
16.	Aniline	5.633	200	93	11	2
17.	Pentachloroethane	5.7	200	167	11	2
18.	Bis(2-chloroethyl)ether	5.743	200	63	11	2
19.	2-Chlorophenol	5.814	200	128	11	2
20.	n-Decane (C10)	5.962	200	57	11	2
21.	1,3-Dichlorobenzene	6.066	200	146	11	2
22.	1,4-Dichlorobenzene-d4	6.154	200	150	11	2
23.	1,4-Dichlorobenzene	6.18	200	148	11	2
24.	Benzyl alcohol	6.393	200	79	11	2
25.	1,2-Dichlorobenzene	6.426	200	111	11	2
26.	2-Methylphenol (o-cresol)	6.611	200	108	11	2
27.	2,2'-Oxybis(1-chloropropane)	6.634	200	45	11	2
28.	N-Nitrosopyrrolidine	6.765	200	100	11	2
29.	Acetophenone	6.825	200	105	11	2
30.	N-Nitrosomorpholine	6.825	200	56	11	2
31.	N-Nitroso-di-n-propylamine	6.825	200	43	11	2
32.	3-Methylphenol (m-cresol)	6.885	200	80	11	2
33.	4-Methylphenol (p-cresol)	6.885	200	107	11	2
34.	Indene	6.885	200	117	11	2
35.	o-Toluidine	6.885	200	106	11	2
36.	Hexachloroethane	6.989	200	119	11	2
37.	Nitrobenzene-d5	7.068	200	82	11	2
38.	Nitrobenzene	7.1	200	123	11	2
39.	N-Nitrosopiperidine	7.347	200	114	17	3
40.	Isophorone	7.531	200	82	17	3
41.	2-Nitrophenol	7.671	200	139	17	3
42.	2,4-Dimethylphenol	7.811	200	122	17	3
43.	Benzoic acid	7.898	200	105	17	3
44.	O,O,O-Triethyl phosphorothioate	7.942	200	121	17	3
45.	Bis(2-chloroethoxy)methane	7.969	200	93	17	3
46.	2,4-Dichlorophenol	8.113	200	162	17	3
47.	α,α-Dimethylphenethylamine (phentermine)	8.178	200	58	17	3
48.	1,2,4-Trichlorobenzene	8.264	200	180	17	3
49.	Naphthalene-d8	8.34	200	136	17	3
50.	Naphthalene	8.378	200	128	17	3
51.	α-Terpineol	8.453	200	59	17	3
52.	4-Chloroaniline	8.518	200	127	17	3
53.	2,6-Dichlorophenol	8.518	200	164	17	3
54.	Hexachloropropene	8.572	200	213	17	3
55.	Hexachlorobutadiene	8.674	200	225	17	3
56.	Quinoline	8.993	200	129	15	4
57.	ε-Caprolactam	9.085	200	55	15	4
58.	1,4-Phenylenediamine	9.160	200	108	15	4
59.	N-Nitrosodibutylamine	9.195	200	84	15	4
60.	4-Chloro-3-methylphenol	9.477	200	107	15	4
61.	Isosafrole isomer 2	9.563	200	181	15	4
62.	2-Methylnaphthalene	9.681	200	142	15	4
63.	1-Methylnaphthalene	9.858	200	141	15	4
64.	1,2,4,5-Tetrachlorobenzene	10.024	200	216	15	4
65.	Hexachlorocyclopentadiene	10.024	200	237	15	4
66.	2,3-Dichloroaniline	10.221	200	161	15	4
67.	Isosafrole isomer 1	10.221	200	104	15	4
68.	2,4,6-Trichlorophenol	10.25	200	196	15	4
69.	2,4,5-Trichlorophenol	10.303	200	198	15	4
70.	2-Fluorobiphenyl	10.41	200	172	15	4
71.	Safrole	10.549	200	131	15	4
72.	Biphenyl	10.586	200	154	15	4
73.	2-Chloronaphthalene	10.586	200	162	15	4
74.	1-Chloronaphthalene	10.624	200	127	15	4
75.	2-Nitroaniline	10.803	200	138	13	5
76.	Diphenyl ether	10.803	200	170	15	5
77.	1,4-Naphthoquinone	10.927	200	158	13	5
78.	1,4-Dinitrobenzene	11.073	200	168	13	5
79.	Dimethylphthalate	11.223	200	163	13	5
80.	1,3-Dinitrobenzene	11.301	200	76	13	5
81.	2,6-Dinitrotoluene	11.301	200	165	13	5
82.	1,2-Dinitrobenzene	11.363	200	50	13	5
83.	Acenaphthylene	11.363	200	152	13	5
84.	3-Nitroaniline	11.591	200	65	13	5
85.	Acenaphthene-d10	11.649	200	162	13	5
86.	Acenaphthene	11.706	200	153	13	5
87.	2,4-Dinitrophenol	11.809	200	184	13	5
88.	4-Nitrophenol	11.996	200	139	13	5
89.	Pentachlorobenzene	11.996	200	250	13	5
90.	Dibenzofuran	12.043	200	84	13	5
91.	2,4-Dinitrotoluene	12.183	200	89	13	5
92.	1-Naphthylamine (1-aminonaphthalene)	12.235	200	143	13	5
93.	2,3,5,6-Tetrachlorophenol	12.339	200	232	13	5
94.	2,3,4,6-Tetrachlorophenol	12.339	200	230	13	5
95.	2-Naphthylamine (2-aminonaphthalene)	12.339	200	115	13	5
96.	Diethylphthalate	12.596	200	149	13	5
97.	n-Hexadecane (C16)	12.703	200	57	29	6
98.	Fluorene	12.703	200	166	29	6
99.	Zalophus (thionazine)	12.746	200	107	29	6
100.	4-Chlorophenyl phenyl ether	12.746	200	204	29	6
101.	4-Nitroaniline	12.746	200	65	29	6
102.	5-Nitro-o-toluidine	12.746	200	152	29	6
103.	4,6-Dinitro-2-methylphenol (Dinitro-o-cresol)	12.852	200	198	29	6
104.	Diphenylamine†	12.98	200	169	29	6
105.	Azobenzene*	13.044	200	77	29	6
106.	2,4,6-Tribromophenol	13.162	200	330	29	6
107.	Sulfotepp	13.385	200	322	14	7
108.	1,3,5-Trinitrobenzene	13.581	200	213	14	7
109.	Phenacetin	13.581	200	108	14	7
110.	Phorate	13.618	200	75	14	7
111.	4-Bromophenyl phenyl ether	13.677	200	248	14	7
112.	Diallate	13.735	200	43	14	7
113.	Hexachlorobenzene	13.788	200	284	14	7
114.	Dimethoate	13.857	200	87	14	7
115.	Atrazine	14.064	200	200	14	7
116.	4-Aminobiphenyl	14.17	200	169	14	7
117.	Pentachlorophenol	14.17	200	266	14	7
118.	Pentachloronitrobenzene (Quintozene)	14.213	200	237	14	7
119.	Propyzamide	14.377	200	173	14	7
120.	Phenanthrene-d10	14.477	200	188	14	7
121.	n-Octadecane (C18)	14.52	200	57	14	7
122.	Phenanthrene	14.52	200	178	14	7
123.	Dinoseb	14.616	200	211	14	7
124.	Disulfoton	14.616	200	88	14	7
125.	Anthracene	14.616	200	179	14	7
126.	Carbazole	14.961	200	167	30	8
127.	Methyl parathion	15.296	200	109	30	8
128.	Di-n-butyl phthalate	15.779	200	149	30	8
129.	4-Nitroquinoline-N-oxide	16.026	200	190	30	8
130.	Parathion (ethyl parathion)	16.075	200	291	30	8
131.	Methapyrilene hydrochloride	16.273	200	58	30	8
132.	Isodrin	16.52	200	193	30	8
133.	Fluoranthene	16.806	200	202	30	8
134.	Benzidine	17.124	200	184	30	8
135.	Pyrene	17.223	200	203	30	8
136.	p-Terphenyl-d14	17.627	200	244	27	9
137.	Aramite isomer 2	17.627	200	175	27	9
138.	Aramite isomer 1	17.818	200	135	27	9
139.	p-Dimethylaminoazobenzene	17.905	200	120	27	9
140.	Chlorobenzilate	18.041	200	251	27	9
141.	Famphur	18.487	200	218	27	9
142.	3,3'-Dimethylbenzidine (o-tolidine)	18.553	200	254	15	9
143.	Kepone	18.553	200	272	27	9
144.	Benzyl butyl phthalate	18.64	200	149	27	9
145.	Bis(2-ethylhexyl)adipate	18.89	200	129	27	9
146.	2-Acetylaminofluorene	19.015	200	181	27	9
147.	4,4'-Methylene-bis(2-chloroaniline)	19.561	200	231	15	9
148.	3,3'-Dichlorobenzidine	19.561	200	212	27	9
149.	Benz[a]anthracene	19.561	200	228	15	10
150.	Chrysene-d12	19.561	200	240	15	10
151.	Chrysene	19.61	200	226	15	10
152.	Bis(2-ethylhexyl)phthalate	19.824	200	167	15	10
153.	6-Methylchrysene	20.473	200	242	15	10
154.	Di-n-octyl phthalate	21.031	200	149	15	10
155.	Benzo[b]fluoranthene	21.589	200	57	15	10
156.	7,12-Dimethylbenz[a]anthracene	21.589	200	256	15	10
157.	Benzo[k]fluoranthene	21.637	200	252	15	10
158.	Benzo[a]pyrene	22.249	200	253	15	10
159.	Perylene-d12	22.377	200	264	15	10
160.	3-Methylcholanthrene	23.08	200	268	15	10
161.	Dibenz(a,h)acridine	24.357	200	279	15	10
162.	Dibenz[a,j]acridine	24.48	200	280	15	10
163.	Indeno[1,2,3-cd]pyrene	24.882	200	277	15	10
164.	Dibenz[a,h]anthracene	24.968	200	278	15	10
165.	Benzo[g,h,i]perylene	25.537	200	276	15	10

References

1. E. Pack, J. Hoisington, C. English, R. Dhandapani, and C. Myers, Comprehensive trace-level semivolatiles analysis by GC-MS/MS (EPA Method 8270E), Application note, EVAN4919-US, Restek Corporation, 2025.
2. RMX GC columns brochure, GNBR4923-UNV, Restek Corporation, 2026.

Featured Products

RMX-5Sil MS GC Capillary Column

Catalog No.	Product Name	Units
17323	RMX-5Sil MS GC Capillary Column, 30 m, 0.25 mm ID, 0.25 µm	ea.

Topaz Single Taper Inlet Liner

Catalog No.	Product Name	Units
23303	Topaz, Single Taper Inlet Liner, 4.0 mm x 6.5 x 78.5, for Agilent GCs, w/Quartz Wool, Premium Deactivation	5-pk.

Restek Electronic Leak Detector

Catalog No.	Product Name	Units
28500	Restek Electronic Leak Detector (includes carrying case; universal AC power adaptor [U.S., UK, Europe, Australia, Japan]; 6-ft USB charging cable)	ea.

SVOC MegaMix 150 Kit, 1 mL/ampul; 6 ampuls/kit

Contains one ampul of each of the following.

Cat.# 31850: 8270 MegaMix
1000 µg/mL each in methylene chloride (3-methylphenol and 4-methylphenol at 500 µg/mL), 1 mL/ampul
Acenaphthene (83-32-9)
Acenaphthylene (208-96-8)
Aniline (62-53-3)
Anthracene (120-12-7)
Azobenzene (103-33-3)*
Benz[a]anthracene (56-55-3)
Benzo[a]pyrene (50-32-8)
Benzo[b]fluoranthene (205-99-2)
Benzo[g,h,i]perylene (191-24-2)
Benzo[k]fluoranthene (207-08-9)
Benzyl alcohol (100-51-6)
Benzyl butyl phthalate (85-68-7)
Bis(2-chloroethoxy)methane (111-91-1)
Bis(2-chloroethyl)ether (111-44-4)
Bis(2-ethylhexyl)adipate (103-23-1)
Bis(2-ethylhexyl)phthalate (117-81-7)
4-Bromophenyl phenyl ether (101-55-3)
Carbazole (86-74-8)
4-Chloroaniline (106-47-8)
4-Chloro-3-methylphenol (59-50-7)
2-Chloronaphthalene (91-58-7)
2-Chlorophenol (95-57-8)
4-Chlorophenyl phenyl ether (7005-72-3)
Chrysene (218-01-9)
Dibenz[a,h]anthracene (53-70-3)
Dibenzofuran (132-64-9)
1,2-Dichlorobenzene (95-50-1)
1,3-Dichlorobenzene (541-73-1)
1,4-Dichlorobenzene (106-46-7)
2,4-Dichlorophenol (120-83-2)
Diethylphthalate (84-66-2)
2,4-Dimethylphenol (105-67-9)
Dimethylphthalate (131-11-3)
Di-n-butyl phthalate (84-74-2)
1,2-Dinitrobenzene (528-29-0)
1,3-Dinitrobenzene (99-65-0)
1,4-Dinitrobenzene (100-25-4)
4,6-Dinitro-2-methylphenol (Dinitro-o-cresol) (534-52-1)
2,4-Dinitrophenol (51-28-5)
2,4-Dinitrotoluene (121-14-2)
2,6-Dinitrotoluene (606-20-2)
Di-n-octyl phthalate (117-84-0)
Diphenylamine (122-39-4)†
Fluoranthene (206-44-0)
Fluorene (86-73-7)
Hexachlorobenzene (118-74-1)
Hexachlorobutadiene (87-68-3)
Hexachlorocyclopentadiene (77-47-4)
Hexachloroethane (67-72-1)
Indeno[1,2,3-cd]pyrene (193-39-5)
Isophorone (78-59-1)
1-Methylnaphthalene (90-12-0)
2-Methylnaphthalene (91-57-6)
2-Methylphenol (o-cresol) (95-48-7)
3-Methylphenol (m-cresol) (108-39-4)
4-Methylphenol (p-cresol) (106-44-5)
Naphthalene (91-20-3)
2-Nitroaniline (88-74-4)
3-Nitroaniline (99-09-2)
4-Nitroaniline (100-01-6)
Nitrobenzene (98-95-3)
2-Nitrophenol (88-75-5)
4-Nitrophenol (100-02-7)
N-Nitrosodimethylamine (62-75-9)
N-Nitroso-di-*n*-propylamine (621-64-7)
2,2'-Oxybis(1-chloropropane) (108-60-1)
Pentachlorophenol (87-86-5)
Phenanthrene (85-01-8)
Phenol (108-95-2)
Pyrene (129-00-0)
Pyridine (110-86-1)
2,3,4,6-Tetrachlorophenol (58-90-2)
2,3,5,6-Tetrachlorophenol (935-95-5)
1,2,4-Trichlorobenzene (120-82-1)
2,4,5-Trichlorophenol (95-95-4)
2,4,6-Trichlorophenol (88-06-2)

Cat.# 31909: SVOC Additions
1000 µg/mL each in methylene chloride, 1 mL/ampul
Acrylamide (79-06-1)
Benzidine (92-87-5)
n-Decane (C10) (124-18-5)
Dibenz(a,h)acridine (226-36-8)
2,3-Dichloroaniline (608-27-5)
3,3'-Dichlorobenzidine (91-94-1)
Dimethoate (60-51-5)
Dinoseb (88-85-7)
Disulfoton (298-04-4)
Famphur (52-85-7)
n-Hexadecane (C16) (544-76-3)
Indene (95-13-6)
Methyl parathion (298-00-0)
6-Methylchrysene (1705-85-7)
4,4'-Methylene-bis(2-chloroaniline) (101-14-4)
n-Octadecane (C18) (593-45-3)
Parathion (ethyl parathion) (56-38-2)
Phorate (298-02-2)
Quinoline (91-22-5)
Sulfotepp (3689-24-5)
α-Terpineol (98-55-5)
o,o,o-Triethyl phosphorothioate (126-68-1)
Zalophus (thionazine) (297-97-2)

Cat.# 32459: Appendix IX mix #1, revised
2000 µg/mL each in methylene chloride, 1 mL/ampul
2-Acetylaminofluorene (53-96-3)
4-Aminobiphenyl (92-67-1)
p-Dimethylaminoazobenzene (60-11-7)
3,3'-Dimethylbenzidine (o-tolidine) (119-93-7)
α,α-Dimethylphenethylamine (phentermine) (122-09-8)
1-Naphthylamine (1-aminonaphthalene) (134-32-7)
2-Naphthylamine (2-aminonaphthalene) (91-59-8)
N-Nitrosodibutylamine (924-16-3)
N-Nitrosodiethylamine (55-18-5)
N-Nitrosomethylethylamine (10595-95-6)
N-Nitrosomorpholine (59-89-2)
N-Nitrosopiperidine (100-75-4)
N-Nitrosopyrrolidine (930-55-2)
5-Nitro-o-toluidine (99-55-8)
1,4-Phenylenediamine (106-50-3)
2-Picoline (109-06-8)
o-Toluidine (95-53-4)

Cat.# 32460: Methapyrilene
2000 µg/mL in methylene chloride, 1 mL/ampul
Methapyrilene hydrochloride (135-23-9)

Cat.# 31806: Appendix IX mix #2
1000 µg/mL each in methylene chloride, 1 mL/ampul
Acetophenone (98-86-2)
Aramite (140-57-8)
Atrazine (1912-24-9)
Benzaldehyde (100-52-7)
Biphenyl (92-52-4)
ε-Caprolactam (105-60-2)
Chlorobenzilate (510-15-6)
1-Chloronaphthalene (90-13-1)
Diallate (2303-16-4)
Dibenz[a,j]acridine (224-42-0)
2,6-Dichlorophenol (87-65-0)
7,12-Dimethylbenz[a]anthracene (57-97-6)
1,4-Dioxane (123-91-1)
Diphenyl ether (101-84-8)
Ethyl methacrylate (97-63-2)
Ethyl methanesulfonate (62-50-0)
Hexachloropropene (1888-71-7)
Isodrin (465-73-6)
Isosafrole (cis & trans) (120-58-1)
Kepone (143-50-0)
3-Methylcholanthrene (56-49-5)
Methyl methanesulfonate (66-27-3)
1,4-Naphthoquinone (130-15-4)
4-Nitroquinoline-N-oxide (56-57-5)
Pentachlorobenzene (608-93-5)
Pentachloroethane (76-01-7)
Pentachloronitrobenzene (Quintozene) (82-68-8)
Phenacetin (62-44-2)
Propyzamide (23950-58-5)
Safrole (94-59-7)
1,2,4,5-Tetrachlorobenzene (95-94-3)
1,3,5-Trinitrobenzene (99-35-4)

Cat.# 31879: Benzoic acid
2000 µg/mL in methylene chloride, 1 mL/ampul
Benzoic acid (65-85-0)

*1,2-diphenylhydrazine (8270-listed analyte) decomposes to azobenzene (mix component) in the injector.
†N-Nitrosodiphenylamine is a reactive species that can initiate premature decomposition of other compounds in the mix. For these reasons, diphenylamine is used in the preparation of this mixture.

Catalog No.	Units
31907	kit

GC-MS Tuning Mix

1000 µg/mL, Methylene Chloride, 1 mL/ampul

Catalog No.	Contains	Units
31615	Benzidine (92-87-5) 4,4'-DDT (50-29-3) DFTPP (decafluorotriphenylphosphine) (5074-71-5) Pentachlorophenol (87-86-5)	ea.

Acid Surrogate Mix (4/89 SOW)

2000 µg/mL, Methanol, 1 mL/ampul

Catalog No.	Contains	Units
31025	2-Fluorophenol (367-12-4) Phenol-d6 (13127-88-3) 2,4,6-Tribromophenol (118-79-6)	ea.

Base Neutral Surrogate Mix (4/89 SOW)

1000 µg/mL, Methylene Chloride, 1 mL/ampul

Catalog No.	Contains	Units
31024	2-Fluorobiphenyl (321-60-8) Nitrobenzene-d5 (4165-60-0) p-Terphenyl-d14 (1718-51-0)	ea.

Revised SV Internal Standard Mix

4000 µg/mL, Methylene Chloride, 1 mL/ampul

Catalog No.	Contains	Units
31886	Acenaphthene-d10 (15067-26-2) Chrysene-d12 (1719-03-5) 1,4-Dichlorobenzene-d4 (3855-82-1) 1,4-Dioxane-d8 (17647-74-4) Naphthalene-d8 (1146-65-2) Perylene-d12 (1520-96-3) Phenanthrene-d10 (1517-22-2)	ea.

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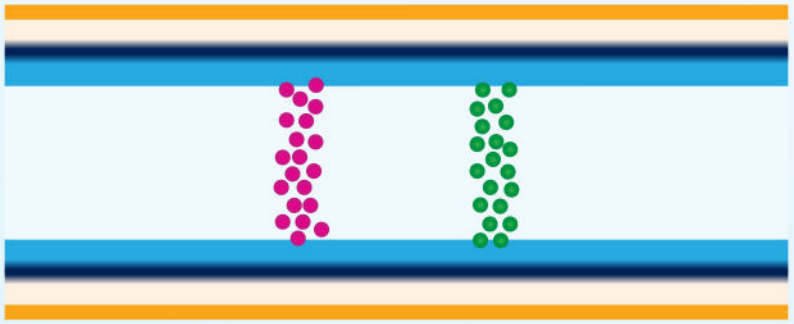

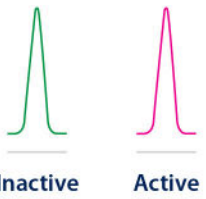

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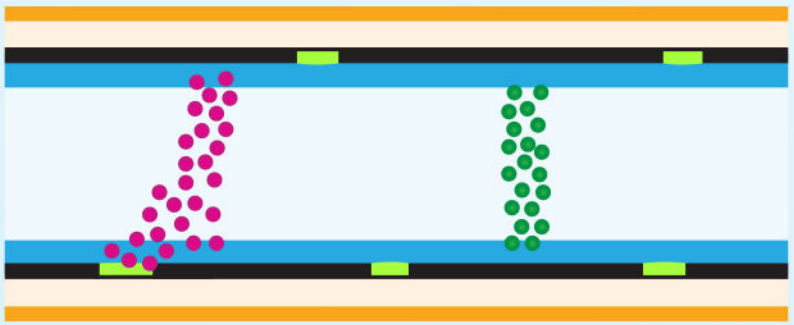

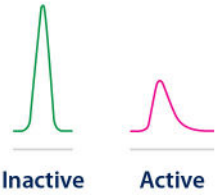

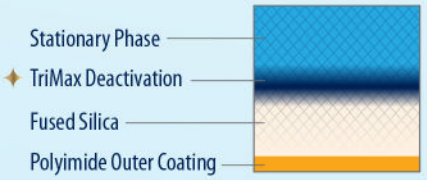

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